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**THE VALIDITY OF TESTS OF CANAL SICKNESS IN PREDICTING  
SUSCEPTIBILITY TO AIRSICKNESS AND SEASICKNESS**

Robert S. Kennedy and Ashton Graybiel



**JOINT REPORT**



**U.S. NAVAL SCHOOL OF AVIATION MEDICINE**

and

**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

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# Research Report

THE VALIDITY OF TESTS OF CANAL SICKNESS IN PREDICTING  
SUSCEPTIBILITY TO AIRSICKNESS AND SEASICKNESS\*

Robert S. Kennedy and Ashton Graybiel

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U. S. NAVAL SCHOOL OF AVIATION MEDICINE  
U. S. NAVAL AVIATION MEDICAL CENTER  
PENSACOLA, FLORIDA

## SUMMARY PAGE

### THE PROBLEM

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Previous experiments at this facility have shown an individual's susceptibility to canal sickness can be demonstrated by a standard procedure aboard the Slow Rotation Room. An additional measure of positive function of the semicircular canals is elicited by caloric irrigation. It was the purpose of the present experiment to determine the validity of these tests in predicting susceptibility to seasickness and airsickness.

### FINDINGS

It was found that a positive relationship existed between performance on the tests of canal sickness and airsickness. This relationship also existed during exposure to heavy seas and to a lesser extent to moderate seas. In general, it may be concluded that the individual's performance on the standard procedure used to produce canal sickness aboard the Slow Rotation Room and his reaction to caloric stimulation are predictive of his susceptibility to air and seasickness.

### ACKNOWLEDGMENTS

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## INTRODUCTION

The experimental production of motion sickness has long been possible, and studies have been performed using swings (13,14), rotating chairs (8,12), vertical accelerators (1-3), and other devices. Further, attempts have been made to relate experimentally produced motion sickness and air and sea sickness by means of past history questionnaires (3,4,18). In general there has been a positive relationship between questionnaire answers and performance in the laboratory, but the problems of this procedure are obvious, since the past experiences of all are not the same. In addition to the foregoing, studies have been reported showing a similar relationship between questionnaire answers and susceptibility in destroyer escort squadrons (5) and on long flights in aircraft (6,11). The difficulty here has been that the procedure may be so long as to make it unwieldy, and the conditions are not always controlled. Also, some investigators consider that the two conditions are not equatable (i.e., sea and air) since they claim that the angular accelerations experienced at sea are barely threshold (for the semicircular canals) whereas the linear accelerations are quite substantial (7). It seems therefore, that short, experimentally repeatable conditions which produce seasickness and airsickness would be valuable, particularly if the results could be predicted by performance in a laboratory setting. The Slow Rotation Room at the U.S. Naval School of Aviation Medicine appears to offer such a condition. The Room is unique in that it places the person in a dynamic rotating environment, but with no external visual reference. A subject is in a room capable of smooth accelerations and constant velocities (1-20 RPM), but without concomitant visual sensations to demonstrate that he is moving. It has been demonstrated with normal subjects and animals that this produces a syndrome termed "canal sickness" (9,10,16,17). It was decided to expose a group of subjects to standardized conditions at sea and in the air to compare their susceptibility with their performance on the Slow Rotation Room and to determine the validity of a standardized procedure used to produce canal sickness (on the Slow Rotation Room) in predicting susceptibility to seasickness and airsickness.

## APPARATUS AND PROCEDURE

### SUBJECTS

Twenty-one male hospital corpsmen ranging in age from 18 to 30 participated in this experiment. All were apparently well motivated and were told that the results of their performance would not be reflected in their service records but the fact that they volunteered would. None had any history or complaints referable to the sensory organs of the inner ears, and medical examination revealed no definite abnormalities.

As the room accelerated to speed (7.5 RPM) the subject was seated in a chair placed three feet from the center of rotation. He was then requested to perform four discrete head movements (upright to 45° left, return to upright, upright to 45° right, return to upright) while gazing at a box with perforations on its edges, and lighted from within in an otherwise darkened room. In most subjects this produces the subjective perception of an apparent movement which is called the "Coriolis oculogyral illusion." The subject was then requested to leave the chair, and while standing by the wall, attempt to walk heel-to-toe toward the center of rotation. These tasks are used to impose certain head movements and impress the subject with the unusualness of the situation. The subject was then seated in another chair and made ready for the dial test. In previous research at this facility (15) the dial test has proved to be an adequate stressor for subjects with usual susceptibility to canal sickness if certain conditions are met. The test itself requires the subject to set a series of five dials, in a prescribed order, for twenty sequences (i.e., 100 dial settings). Each dial requires the subject to move his head through two axes of rotation. Each dial faces about 180 degrees out of phase with the one which preceded it. The numbers which the subject was to set were prerecorded on tape, and six seconds were allowed for each of the one hundred settings. The subject was advised that he was to make as many settings as he could, as accurately as he could, without getting sick. He was instructed that, if he felt the continuation of the dial test would cause him to be sick, he was to inform the experimenter and the SRR would stop. His score was the total number of sequences (maximum 20) he completed.

In addition, caloric stimulation was performed by irrigating the subjects' ears with water at 35 degrees centigrade, and nystagmic output was observed through Frenzel spectacles. The responses were rated as being: 0 - no response; 1 - weak response; 2 - good response.

During each of the three experimental conditions the subject was in view of the experimenter. At the conclusion of a run (or when terminated at his request) the subject was questioned to determine what symptoms he experienced if any. The subject was then listed as having 1) completed-asymptomatic, 2) completed but with symptoms, 3) not completed because of sickness.

Table II contains the results when eleven subjects were exposed to the aircraft procedures, the Slow Rotation Room, and to a moderate sea condition (condition 2). It may be noted that here as in Table I the same relationship appears to exist between air and the Slow Rotation Room. In this group the state of the sea was much calmer, and the subjects reported less sickness and fewer symptoms.

Table II

Motion Sickness Symptomatology in Eleven Subjects in Flight and on Moderate Seas  
Compared to Performance in Slow Rotation Room

Subjects	Dial Test Score (SRR)	SRR	Aircraft	Moderate Sea
11	20	X*	X	X
12	20	X	X	X
13	20	X	Stomach Aware	X
14	20	X	Sick	X
15	15	Sick	Nausea	Stomach Aware
16	13	Sick	Nausea	X
17	13	Sick	Sick	Sick
18	10	Sick	Perspiration	Stomach Aware
19	9	Sick	Nausea	Perspiration
20	7	Sick	X	Stomach Aware
21	2	Sick	X	X

\* X Completed task - Asymptomatic

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